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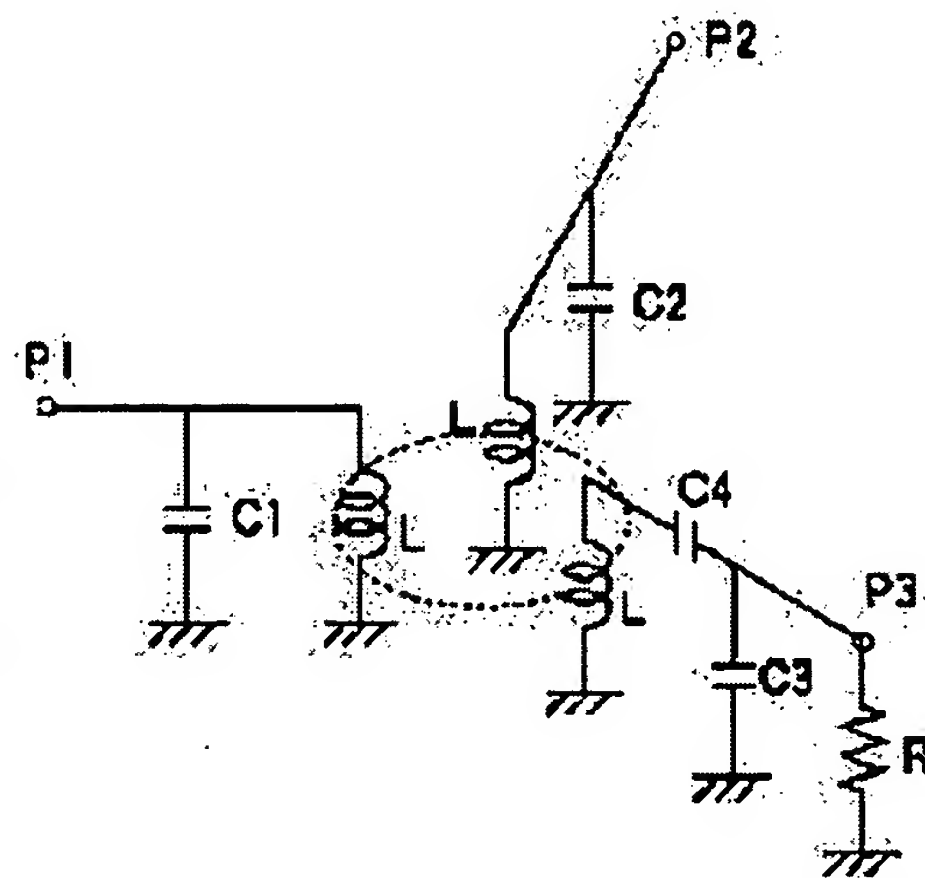
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## (54) IRREVERSIBLE CIRCUIT ELEMENT

## (57)Abstract:

PURPOSE: To provide a small-sized and inexpensive irreversible circuit element of high reliability and high quality where the print resistance is easily measured and trimmed.

CONSTITUTION: The matching circuit of the terminating port of an isolator consists of a parallel capacity C3 and a serial capacity C4. By this constitution, the circuit between an inductance L obtained by the center electrode and a terminating resistance R is open in DC, and the terminating resistance R (print resistance) can be measured and trimmed, and the isolator of more proper matching is formed. If a serial inductance is added to the matching circuit, the terminating resistance can be set to any value, and further, the matching condition is easily set and adjusted, and it is easily changed to a circulator.



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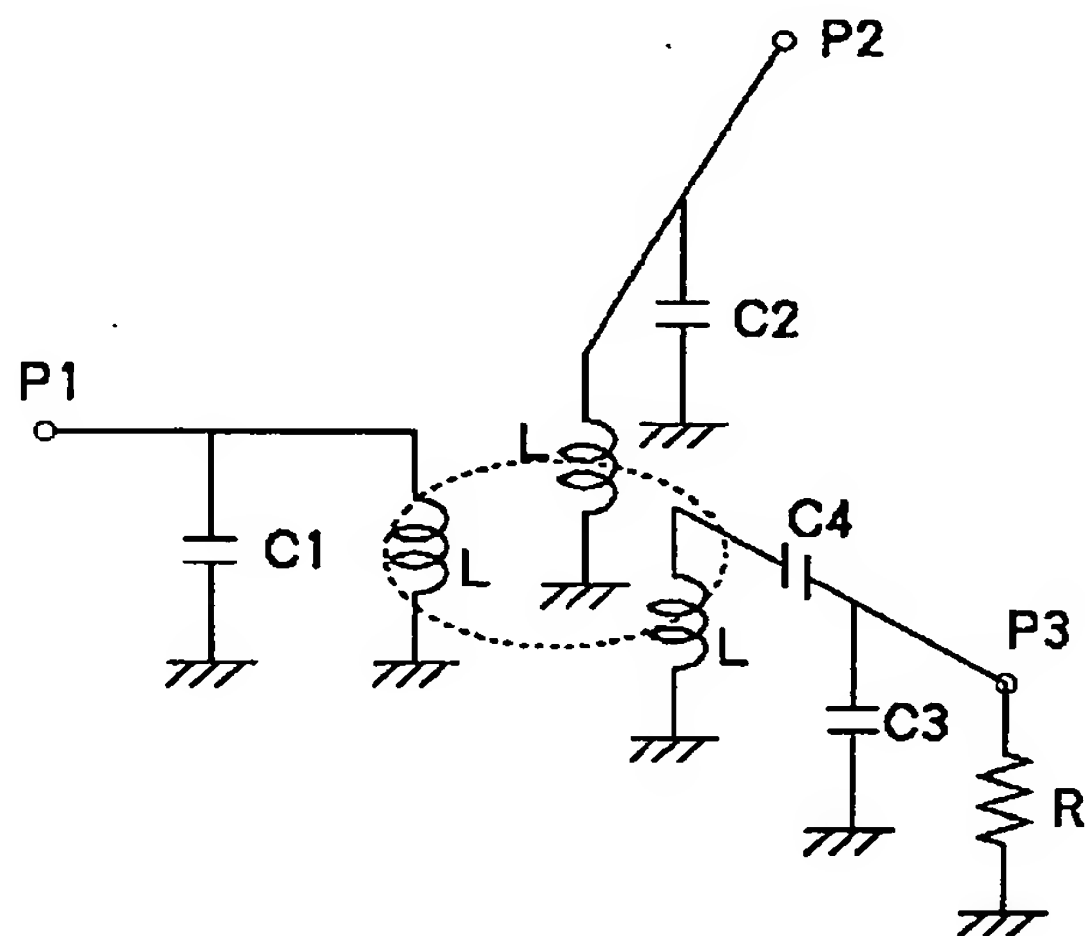
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(54) 【発明の名称】 非可逆回路素子

(57) 【要約】

【目的】印刷抵抗の測定、トリミングを容易に行うことができ、小型かつ安価で、信頼性が高く高品位な非可逆回路素子を提供する。

【構成】アイソレータの終端ポートの整合回路を並列容量 C 3 と直列容量 C 4 で構成する。この構成により中心電極で得られるインダクタンス L と終端抵抗 R 間は直流的にオープンとなり終端抵抗 R (印刷抵抗) の測定、トリミングが可能となり、より適正な整合のアイソレータを形成することができる。また、上記整合回路にさらに直列インダクタンスを付加して構成すれば、終端抵抗をどのような値とすることも可能となり、さらに整合条件の設定、調整を容易にでき、サーキュレータへの変更も容易にできる。



## 【特許請求の範囲】

【請求項 1】 複数の中心電極を交差するように配置し、該中心電極の交差部分にフェライトを当接させるとともに直流磁界を印加し、前記各中心電極の一端部と各ポート間に整合回路を接続し、他端部をアースに接続してなる非可逆回路素子において、前記ポートの少なくとも 1 つのポートの整合回路内に直列容量を含むことを特徴とする非可逆回路素子。

【請求項 2】 前記少なくとも 1 つのポートの整合回路を並列容量と直列容量で構成し、この並列容量と直列容量で構成された整合回路の 1 つに終端抵抗を接続したことを特徴とする請求項 1 に記載の非可逆回路素子。

【請求項 3】 前記少なくとも 1 つのポートの整合回路を並列容量と直列容量及び直列インダクタンスで構成したことを特徴とする請求項 1 に記載の非可逆回路素子。

【請求項 4】 前記並列容量と直列容量及び直列インダクタンスで構成された整合回路の 1 つに終端抵抗を接続したことを特徴とする請求項 3 に記載の非可逆回路素子。

【請求項 5】 前記終端抵抗として印刷抵抗を用いたことを特徴とする請求項 2 及び請求項 4 に記載の非可逆回路素子。

【請求項 6】 前記整合回路及び各中心電極の一部または全てを多層基板の内部あるいは表面に形成したことを特徴とする請求項 1 乃至請求項 5 に記載の非可逆回路素子。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は、自動車電話、携帯電話等の通信機器に使用される非可逆回路素子、例えばアイソレータ、サーキュレータに関する。

## 【0002】

【従来の技術】一般に、アイソレータ、サーキュレータ等の非可逆回路素子は、信号を伝送方向のみに通過させ、逆方向への伝送を阻止する機能を有しており、自動車電話、携帯電話等の移動体通信機器の送信回路部に使用されている。

【0003】このような非可逆回路素子の従来の等価回路図を図 10 に示す。図 10 はポート P1、P2、P3 に整合回路として並列容量 C1、C2、C3 が接続されたサーキュレータのいずれか 1 つのポート（図ではポート P3）に終端抵抗 R を接続したアイソレータの等価回路図である。

【0004】このようなアイソレータとして、例えば図 11 に示すような構造のものがある。以下の図において、各種電極（パターン）形成部には点塗り潰しを施して示す。

【0005】このアイソレータは、図 11 に示すように、下部ヨーク 21 内の底壁上にフェライト 22 を配置し、このフェライト 22 を覆うように、その中央部にフ

ェライト 22 が嵌合する穴が設けられた入出力基板 23 とこの入出力基板 23 と一体化された誘電体多層基板 10 が載置され、下面に永久磁石 24 が取り付けられた上部ヨーク 25 を下部ヨーク 21 に装着して磁気閉回路を形成するとともに、永久磁石 24 により上記フェライト 22 に直流磁界を印加するように構成されている。

【0006】多層基板 10 上には終端抵抗としてチップ抵抗 6 がはんだ付けされ、入出力基板 23 には入出力電極 23a、23b 及びアース電極 1 が形成され、この入出力基板 23 の下面の凹部に形成されたアース電極（図示せず）と下部ヨーク 21 の底壁は、はんだ付けにて接続、固定されている。

【0007】入出力基板 23 と多層基板 10 は、はんだ付けあるいはグリーンシートの段階で積層、焼成して一体化され、多層基板 10 の下面に形成されたポート電極、アース電極は入出力基板 23 のそれぞれの対応する電極 23a、23b、1 に接続されている。永久磁石 24 は接着剤で上部ヨークに貼着され、下部ヨーク 21 と上部ヨーク 25 は、軟鉄等の磁性体金属からなり、はんだ付けにて接続、固定されている。

【0008】そして、従来の多層基板 10 は、図 12 に示すように、厚さ数十  $\mu\text{m}$  程度の多数の誘電体セラミックグリーンシート 11～19 の表面に各種電極をパターン印刷等により形成し、この各シートを積層して圧着し、焼成して一体化されたものであり、各シート 11～19 に形成された各種電極は、スルーホールにより所定箇所て接続されて構成されている。なお、以下の図において、各ポート電極に対応するスルーホールまたはビアホールを二点鎖線で接続して示す。

【0009】具体的には、最上層のシート 11 には終端ポート電極 5c 及びアース電極 1 が、シート 12、14、16 にはアース電極 1 が、シート 13、15 には容量電極 3a、3b、3c が、下層を構成するシート 17、18、19 には中心電極 2a、2b、2c が形成されている。最下層のシート 19 の下面にはアース電極 1 及び入出力ポート電極 5a、5b が形成されている。

【0010】各中心電極 2a、2b、2c は互いに 120 度の角度をなすように形成積層され、その一端部はそれぞれポート電極 5a、5b、5c に、他端部はアース電極 1 にスルーホールで接続されている。

【0011】この構成により、図 10 に示す並列容量 C1、C2、C3 は、シート 13、15 に形成されたそれぞれの容量電極 3a、3b、3c とシート 12、14、16 に形成されたアース電極 1 との間のそれぞれ 4 つの電極間容量で形成されている。なお、インダクタンス L、L、L は、フェライトと中心電極 2a、2b、2c とにより形成される等価的なインダクタンスである。

【0012】そして、従来のアイソレータでは、図 11 に示すように、上記多層基板 10 上面の終端ポート電極 5c とアース電極 1 間に、図 10 に示す終端抵抗 R とし

て、チップ抵抗 6 をはんだ付けして形成している。

【0013】しかし、チップ抵抗を用いた場合、チップ抵抗の厚みのため、アイソレータのさらなる小形化（薄形化）が困難であり、また、はんだ付けにより接続されているので、はんだ付け不備等による接続の信頼性が低いという問題があった。

【0014】そこで、図 13 に示すように、終端ポート電極 5c とアース電極 1 間に、印刷等により形成した抵抗 7（以下、印刷抵抗と記す）を終端抵抗 R として用いて、小形化及び接続等の信頼性の向上を図る方法が採用

されている。

【0015】

【発明が解決しようとする課題】しかしながら、上記のように印刷抵抗を用いた場合は、小形化（薄形化）には寄与できるが、精度のよい抵抗値を得ることができないという問題がある。

【0016】このため、予め、小さめの抵抗値となるように印刷抵抗を形成し、印刷抵抗形成後に抵抗値を測定しながらトリミングにより抵抗値を調整することが必要であり、また、この抵抗値測定には電圧の印加が必要で

ある。

【0017】ところが、上記従来の図 10 に示す等価回路図、及びこの等価回路に基づいて形成される図 12 に示す多層基板では、終端抵抗あるいは印刷抵抗が接続される終端ポート電極とアース電極は直流的に短絡（ショート）しており、抵抗値の測定ができないという問題があった。このため、図 14 に示すように、多層基板 10（シート 11）上面のアース電極 1 の一部 1a を削り取るか、あるいは予め印刷せずに、印刷抵抗 7 の両端がショートしないようにして、印刷抵抗 7 をトリミングした

後、導電ペースト等で導通する方法を用いていた。

【0018】しかし、この方法では、接続の信頼性が低くなり、アース電極削除部を接続する等の作業工数が増加し製造コストが高くなるという問題があった。また、抵抗の再調整が必要となった場合、導電ペースト等を削除し抵抗トリミング後、再度導通する必要があった。

【0019】そこで、本発明の目的は、以上のような従来の非可逆回路素子が持つ問題点を解消し、印刷抵抗のトリミングを容易に行うことができ、小型かつ安価で、信頼性が高く高品位な非可逆回路素子を提供することにある。

【0020】

【課題を解決するための手段】上記目的を達成するために、本発明の請求項 1 に係る発明は、複数の中心電極を交差するように配置し、該中心電極の交差部分にフェライトを当接させるとともに直流磁界を印加し、前記各中心電極の一端部と各ポート間に整合回路を接続し、他端部をアースに接続してなる非可逆回路素子において、前記ポートの少なくとも 1 つのポートの整合回路内に直列容量を含むことを特徴とするものである。

【0021】請求項 2 に係る発明は、請求項 1 に記載の非可逆回路素子において、少なくとも 1 つのポートの整合回路を並列容量と直列容量で構成し、この並列容量と直列容量で構成された整合回路の 1 つに終端抵抗を接続したことを特徴とするものである。

【0022】請求項 3 に係る発明は、請求項 1 に記載の非可逆回路素子において、少なくとも 1 つのポートの整合回路を並列容量と直列容量及び直列インダクタンスで構成したことを特徴とするものである。

【0023】請求項 4 に係る発明は、請求項 3 に記載の非可逆回路素子において、並列容量と直列容量及び直列インダクタンスで構成された整合回路の 1 つに終端抵抗を接続したことを特徴とするものである。

【0024】請求項 5 に係る発明は、請求項 2 及び請求項 4 に記載の非可逆回路素子において、終端抵抗として印刷抵抗を用いたことを特徴とするものである。

【0025】請求項 6 に係る発明は、請求項 1 乃至請求項 5 に記載の非可逆回路素子において、整合回路及び各中心電極の一部または全てを多層基板の内部あるいは表面に形成したことを特徴とするものである。

【0026】

【作用】上記の構成によれば、終端抵抗が接続されるポートの整合回路内に直列容量を含んで構成することができ、終端抵抗と中心電極間を直流的にオープンとすることができる。すなわち、終端抵抗として印刷抵抗を用いた場合でも、工程のどの段階においても抵抗の測定、調整（トリミング）を行うことができる。また、この直列容量が付加されたことにより、整合回路を構成するパラメータが増え、整合条件の設定、調整をより適正に行うことができる。さらに整合回路に上記直列容量に加え、直列インダクタンスを付加すれば、整合条件の設定、調整をさらに容易にかつ適正に行うことができる。また、整合回路内に直列容量と直列インダクタンスを付加した場合は、終端抵抗はどのような値に設定することもでき、また、この場合、終端抵抗を接続せず構成すれば、容易にサーキュレータとすることができる。

【0027】また、終端抵抗は、はんだ付け、導電ペースト等を用いることなく接続できる。

【0028】また、中心電極、整合回路等を多層基板で形成することにより、より小型化（薄型化）が実現できる。

【0029】

【実施例】以下、本発明をその実施例を示す図面に基づいて具体的に説明する。図において、従来例と同一部分または相当する部分については同一符号を付す。以下の実施例のアイソレータの全体構造は、従来例の図 11 に示したものと同様の構造であり、終端抵抗としてチップ抵抗に代えて印刷抵抗を用いたものであり、図示及びその説明を省略する。

【0030】本発明の第 1 実施例であるアイソレータの



等価回路図を図 1 及び図 2 に示す。図 1 及び図 2 の等価回路図に示すように、この実施例のアイソレータは終端ポート P 3 の整合回路を並列容量 C 3 と直列容量 C 4 で構成したものであり、終端ポート P 3 には終端抵抗 R が接続されている。入出力ポート P 1, P 2 の整合回路は従来例と同様に並列容量 C 1, C 2 で構成されている。

【0031】すなわち、図 1 に示す等価回路は、従来例の図 10 に示す等価回路において、中心電極を等価的に示すインダクタンス L と並列容量 C 3 間に直列容量 C 4 を付加して構成され、図 2 に示す等価回路は、並列容量 C 3 と終端抵抗 R 間に直列容量 C 4 を付加して構成されている。この場合、整合インピーダンスは従来のものより低くなり、終端抵抗 R は従来のものより低く設定される。

【0032】このような回路構成にすれば、直列容量 C 4 により終端抵抗 R の両端が直流的にオープンとなり、抵抗値の測定が可能となる。

【0033】また、アイソレータの小形化にともない、一般的にアイソレータの挿入損失が大きくなると、インダクタンス L は純粋なインダクタンス成分とみなせなくなり、並列容量 C 3 のみでは適正な整合がとれなくなる。しかし、この構成においては、終端ポート P 3 の整合回路が並列容量 C 3 と直列容量 C 4 との 2 つの回路素子で構成されているので、この 2 つの容量を適宜設定、調整することにより、適正な整合をとることができる。したがって、終端抵抗での反射を完全に打ち消し、アイソレータの性能をより向上することができる。

【0034】上記図 1 に示す等価回路を実現する多層基板の構造を図 3 に示す。この実施例の多層基板 10 は、厚さ数十  $\mu\text{m}$  程度の多数の誘電体セラミックグリーンシート 11 ~ 19 の表面に各種電極をパターン印刷等により形成し、この各シートを積層して圧着し、焼成して一体化されており、各シート 11 ~ 19 に形成された各種電極は、スルーホールにより所定箇所て接続されて構成されている。

【0035】多層基板 10 を構成するシート 14 にはアース電極 1 と容量電極 3 d が形成されている。この容量電極 3 d は、シート 13、15 の容量電極 3 c に対応する位置に形成され、シート 17 の中心電極 2 c にスルーホールにより接続されている。シート 13 の容量電極 3 c の両端及びこれに対応するシート 14 の位置であって、容量電極 3 d 両端の外側にはスルーホールが形成され、このスルーホールによりシート 13 の容量電極 3 c とシート 15 の容量電極 3 c は接続されている。

【0036】そして、シート 13 の容量電極 3 c の中央部にはスルーホールを形成せずに、シート 11 の終端ポート電極 5 c とシート 17 の中心電極 2 c が導通しないように構成されている。

【0037】多層基板 10 の上面すなわちシート 11 上の終端ポート電極 5 c とアース電極 1 間には印刷抵抗 7

が接続されている。上記以外の構成については、従来例の図 12 に示したものと同様の構成であり、その説明を省略する。

【0038】この構成により、図 1 に示す並列容量 C 1, C 2 は、シート 13、15 のそれぞれの容量電極 3 a, 3 b とシート 12、14、16 のアース電極 1 との間に形成されるそれぞれ 4 つの電極間容量で形成され、並列容量 C 3 は、シート 13、15 の容量電極 3 c とシート 12、16 のアース電極 1 との間に形成される 2 つの電極間容量で形成されている。

【0039】直列容量 C 4 は、シート 14 の容量電極 3 d とシート 13、15 の容量電極 3 c との間に形成される 2 つの電極間容量で形成され、インダクタンス L と並列容量 C 3 間に直列に付加されている。

【0040】次に図 2 に示す等価回路を実現する多層基板の構造を図 4 に示す。この実施例の多層基板 10 と図 3 に示す多層基板 10 との異なるところは、シート 13 の容量電極 3 c の中央部にこの容量電極 3 c と分離するスルーホールを設け、シート 15 の容量電極 3 c はスルーホールと導通するように形成され、シート 14 の容量電極 3 d にはスルーホールが形成されていないことである。つまり、シート 14 の容量電極 3 d は終端ポート電極 5 c と導通し、中心電極 2 c とは導通しないように構成されている。上記以外の構成については、図 3 に示したものと同一の構成であり、その説明を省略する。

【0041】この構成により、図 2 に示す直列容量 C 4 は、シート 14 の容量電極 3 d とシート 13、15 の容量電極 3 c との間に形成される 2 つの電極間容量で形成され、終端抵抗 R と並列容量 C 3 間に直列に付加されている。他の並列容量 C 1, C 2, C 3 は図 3 で説明したものと同様の電極間容量で形成されている。

【0042】本発明の第 2 実施例であるアイソレータの等価回路図を図 5 及び図 6 に示す。図 5 及び図 6 の等価回路図に示すように、この実施例のアイソレータは終端ポート P 3 の整合回路を並列容量 C 3 に直列容量 C 4 と直列インダクタンス L 1 を付加して構成したものであり、終端ポート P 3 には終端抵抗 R が接続されている。入出力ポート P 1, P 2 の整合回路は従来例と同様に並列容量 C 1, C 2 で構成されている。

【0043】すなわち、図 5 に示す等価回路は、従来例の図 10 に示す等価回路において、中心電極で得られるインダクタンス L と並列容量 C 3 間に直列容量 C 4 と直列インダクタンス L 1 を付加して構成され、図 6 に示す等価回路は、並列容量 C 3 と終端抵抗 R 間に直列容量 C 4 と直列インダクタンス L 1 を付加して構成されている。

【0044】この場合、整合インピーダンスは直列容量 C 4 と直列インダクタンス L 1 の値によりどのような値にも設定でき、よって、終端抵抗 R はどのような値にも設定することが可能となる。

【0045】このような回路構成にすれば、直列容量C4により終端抵抗Rの両端が直流的にオープンとなり、抵抗値の測定が可能となる。

【0046】また、この構成においては、終端ポートP3の整合回路が並列容量C3と直列容量C4と直列インダクタンスL1の3つの回路素子で構成されているので、これらの3つの値を適宜設定、調整することにより、最適な整合をとることができる。したがって、終端抵抗での反射を完全に打ち消し、アイソレータの性能をより向上することができる。

【0047】さらに、この構成では、アイソレータ動作周波数で、直列容量C4と直列インダクタンスL1とを共振するように設定すれば、終端抵抗Rを従来例のものと同一の値とすることが可能となる。また、この場合、ポートP3に終端抵抗Rを接続せずにサーキュレータとして使用することもできる。

【0048】また、この整合回路は、他のポートP1、P2にも適用することができる。

【0049】上記図5に示す等価回路を実現する多層基板の構造を図7に示す。この実施例の多層基板10を構成するシート17には中心電極2cと導通するインダクタンス電極4cが形成されている。つまり、中心電極2cとインダクタンス電極4cとは略L字状の一体のパターンとして形成されている。

【0050】インダクタンス電極4cの先端部は、シート16、15、14のスルーホールによりシート14の容量電極3dに接続されている。上記以外の構成については第1実施例の図3に示すものとほぼ同様の構成となっており、シート13、14、15、16のスルーホール形成位置、容量電極の大きさ等を若干変更して形成されている。

【0051】この構成により、図5に示す直列インダクタンスL1は中心電極2cに導通するインダクタンス電極4cで形成されている。並列容量C1、C2、C3及び直列容量C4は図3で説明したものと同様の電極間容量で形成されている。

【0052】次に、図6に示す等価回路を実現する多層基板の構造を図8に示す。この実施例の多層基板10を構成するシート11には終端ポート電極5cと導通するインダクタンス電極4cが形成されている。つまり、終端ポート電極5cの印刷抵抗7の反対側にインダクタンス電極4cが形成されている。

【0053】インダクタンス電極4cの先端部は、シート11、12、13のスルーホールによりシート14の容量電極3dに接続されている。上記以外の構成については第1実施例の図3に示すものとほぼ同様の構成となっており、シート12、13、14、15のスルーホール形成位置、容量電極の大きさ等を若干変更して形成されている。

【0054】この構成により、図6に示す直列インダク

タンスL1は終端ポート電極5cに導通するインダクタンス電極4cで形成されている。並列容量C1、C2、C3及び直列容量C4は図3及び図4で説明したものと同様の電極間容量で形成されている。図7及び図8の構造においても、終端ポート電極5cと中心電極2cは導通しないように構成されている。

【0055】なお、上記第2実施例では、直列容量C4及び直列インダクタンスL1を中心電極を示すインダクタンスLと並列容量C3間に、あるいは終端抵抗Rと並列容量C3間に付加したが、これに限ることはなく、図9(a)に示すように、インダクタンスLと並列容量C3間に直列容量C4を、終端抵抗Rと並列容量C3間に直列インダクタンスL1を付加するようにしてもよく、あるいは図9(b)に示すように、インダクタンスLと並列容量C3間に直列インダクタンスL1を、終端抵抗Rと並列容量C3間に直列容量C4を付加するようにしてもよい。

【0056】また、上記各実施例では、より小形化を図るために多層基板で中心電極、整合回路を構成したものであるが、これに限るものではなく、中心電極を金属製の導体で形成したもの、整合回路を基板にディスクリートのコンデンサ、コイル等を実装して構成したものでもよい。

【0057】要するに、本発明は、非可逆回路素子の整合回路内に直列容量を付加して、中心電極とポート端が直流的にオープンとなるように構成したことを特徴とするものであり、他の構成、構造については、特に限定するものではない。

【0058】

【発明の効果】以上説明したように、本発明に係る非可逆回路素子によれば、少なくとも1つのポートの整合回路内に直列容量を付加して、中心電極とポート端が直流的にオープンとなるように構成されており、この直列容量が付加されたポートに終端抵抗として印刷抵抗を接続したアイソレータにおいて、抵抗の測定が可能となり、印刷抵抗の測定、調整をすることができる。つまり、従来の印刷抵抗を使用したアイソレータにおいて必要であった印刷抵抗を調整するためのアース電極の一部削除、及び印刷抵抗調整後アース電極削除部を再び導通するための工数を不要とし、製造コストを大幅に低減できるとともに接続の信頼性の低下も起こらない。

【0059】また、製造工程のどの段階においても容易に抵抗値調整が可能となり抵抗値の調整精度を向上できる。また、整合回路に直列容量が付加されたことにより、整合回路を構成するパラメータが増え、設計での整合条件の設定、調整をより容易にかつ適正に行うことができ、アイソレータの性能を向上することができる。

【0060】さらに、整合回路に上記直列容量に加え、直列インダクタンスを付加すれば、整合条件の設定、調整をさらに容易にかつ適正に行うことが可能となり、最

適な整合を得ることができ、アイソレータの性能をさらに向上することができる。

【0061】また、整合回路内に直列容量と直列インダクタンスを付加した場合は、終端抵抗はどのような値に設定することもでき、また、この場合、終端抵抗を接続せず構成すれば、容易にサーキュレータとすることができる。

【0062】したがって、本発明によれば、印刷抵抗のトリミングを容易に行うことができ、アイソレータとサーキュレータとの変更を容易に行うことができる、小型かつ安価で、信頼性が高く高品質な非可逆回路素子を提供することができる。

#### 【図面の簡単な説明】

【図1】本発明の第1実施例に係るアイソレータの1つの等価回路図である。

【図2】本発明の第1実施例に係るアイソレータの他の等価回路図である。

【図3】図1の等価回路図に対応する多層基板の分解斜視図である。

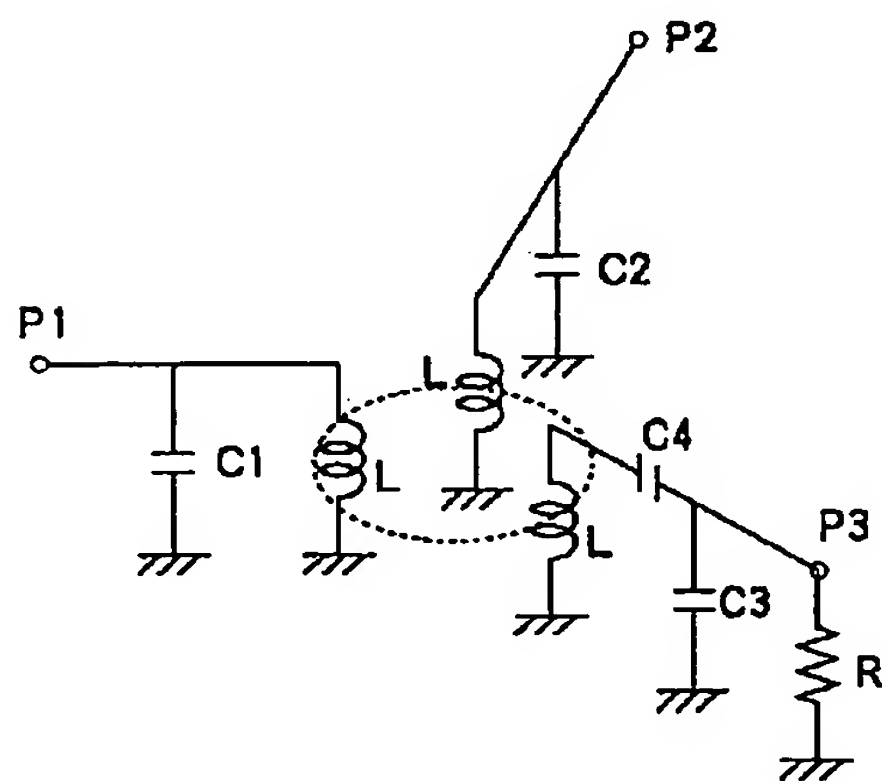
【図4】図2の等価回路図に対応する多層基板の分解斜視図である。

【図5】本発明の第2実施例に係るアイソレータの1つの等価回路図である。

【図6】本発明の第2実施例に係るアイソレータの他の等価回路図である。

【図7】図5の等価回路図に対応する多層基板の分解斜視図である。

【図1】



【図8】図6の等価回路図に対応する多層基板の分解斜視図である。

【図9】(a)及び(b)は第2実施例のアイソレータの別の等価回路図である。

【図10】従来のアイソレータの等価回路図である。

【図11】従来のアイソレータの全体構造の一例を示す分解斜視図である。

【図12】図10の等価回路図に対応する多層基板の分解斜視図である。

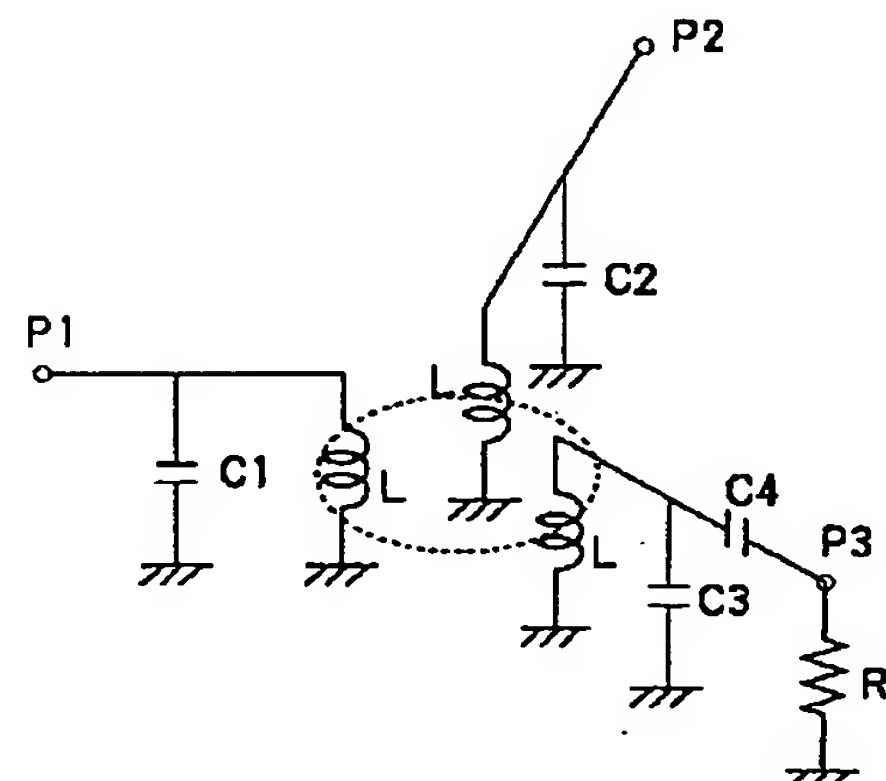
【図13】印刷抵抗を形成した多層基板の斜視図である。

【図14】従来の印刷抵抗を形成した多層基板の抵抗トリミング時の斜視図である。

#### 【符号の説明】

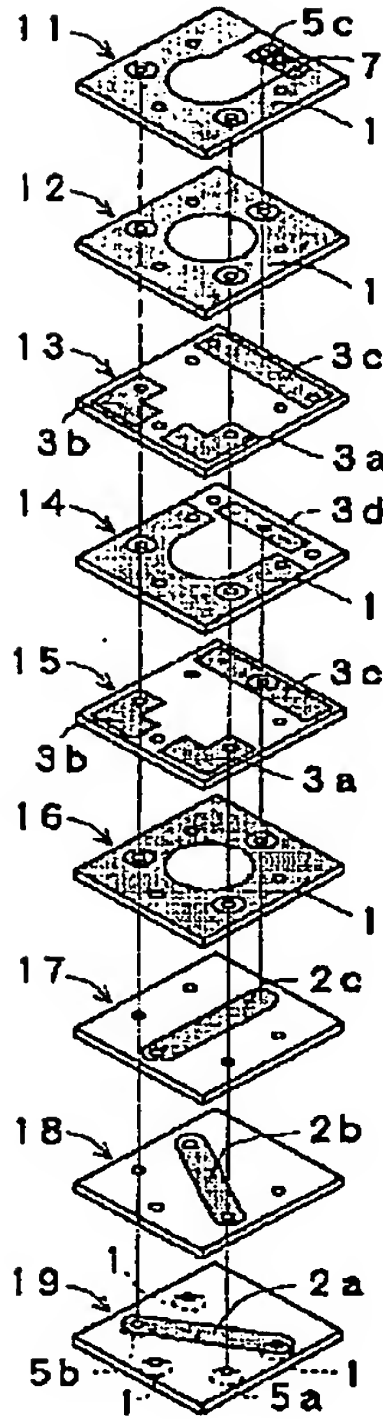
P 1, P 2, P 3	ポート
C 1, C 2, C 3	並列容量
C 4	直列容量
L 1	直列インダクタンス
R	終端抵抗
1	アース電極
2 a, 2 b, 2 c	中心電極
3 a, 3 b, 3 c, 3 d	容量電極
4 c	インダクタンス電極
5 a, 5 b, 5 c	ポート電極
7	印刷抵抗
1 0	多層基板
1 1 ~ 1 9	セラミックシート

【図2】

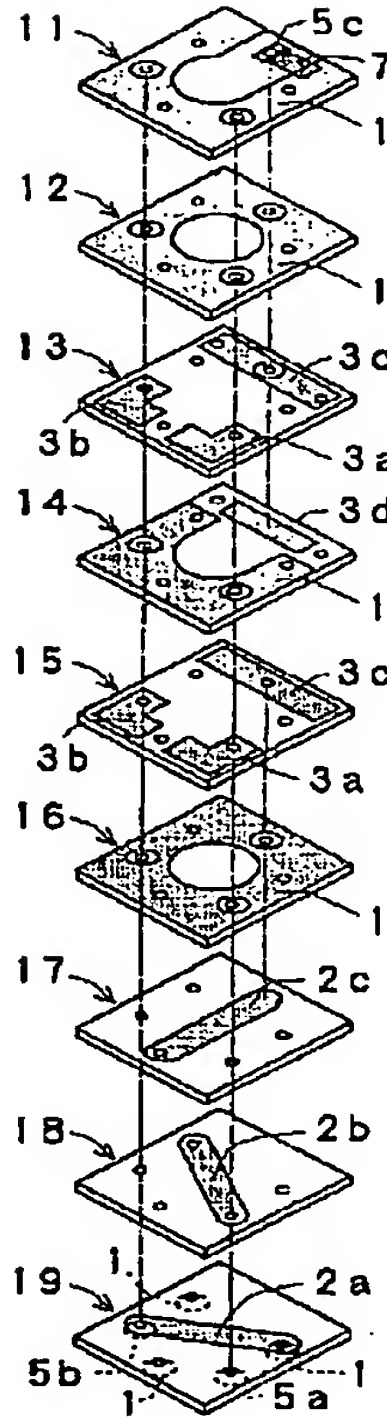




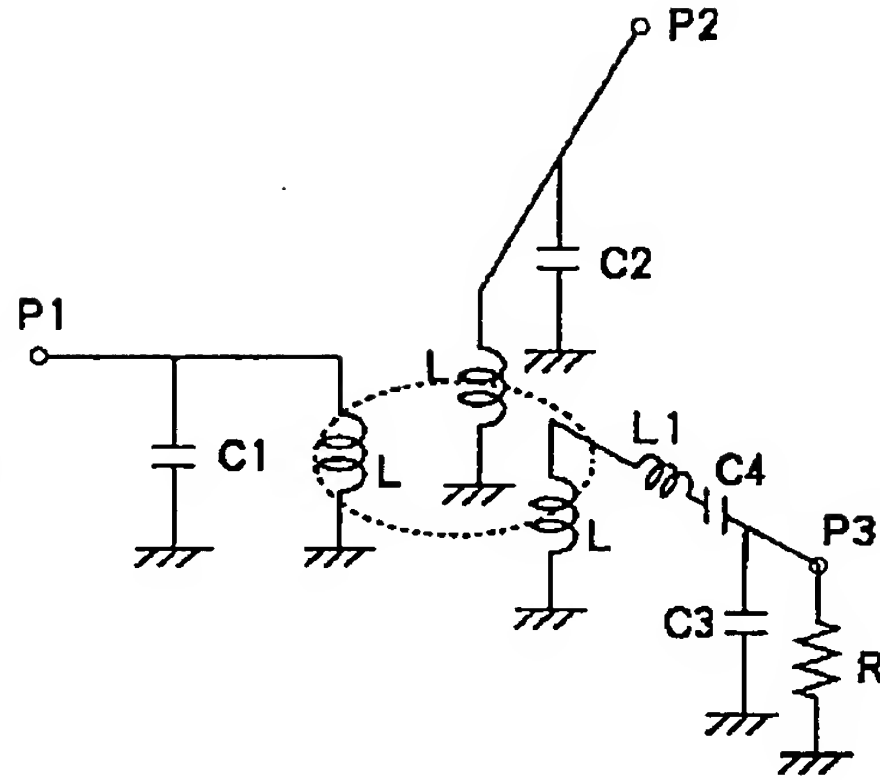
【図 3】



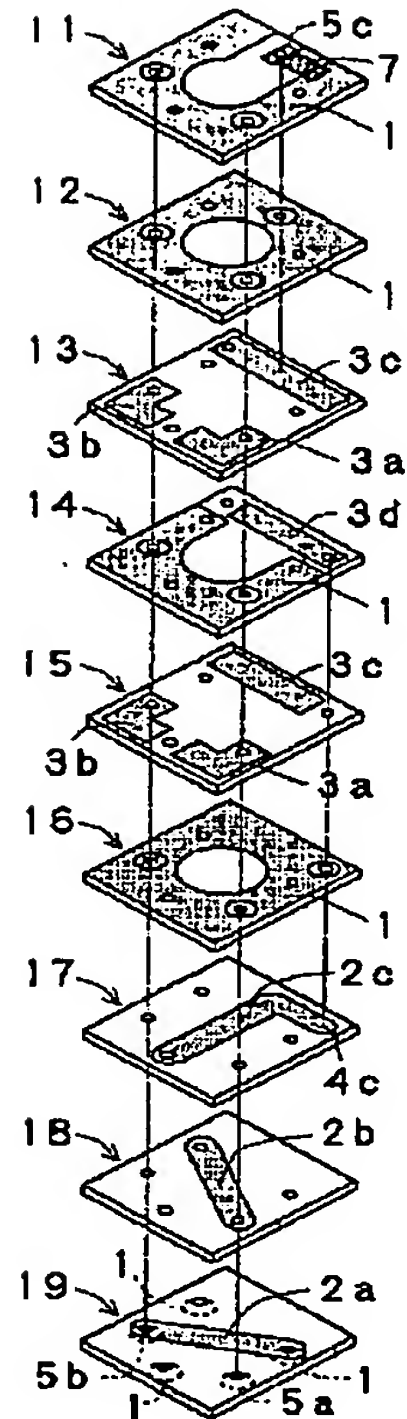
【図 4】



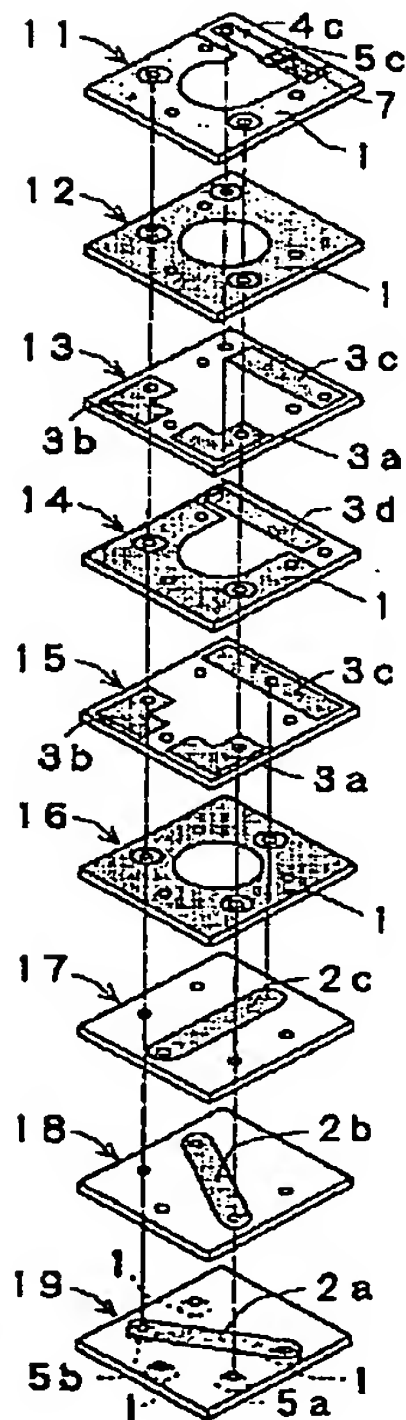
【図 5】



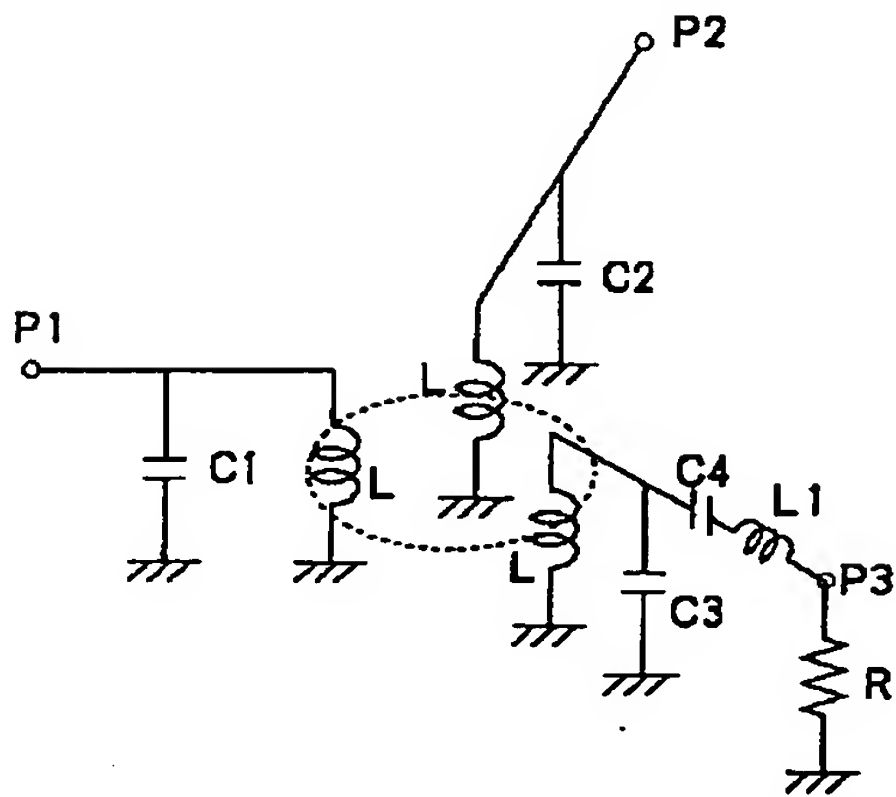
【図 7】



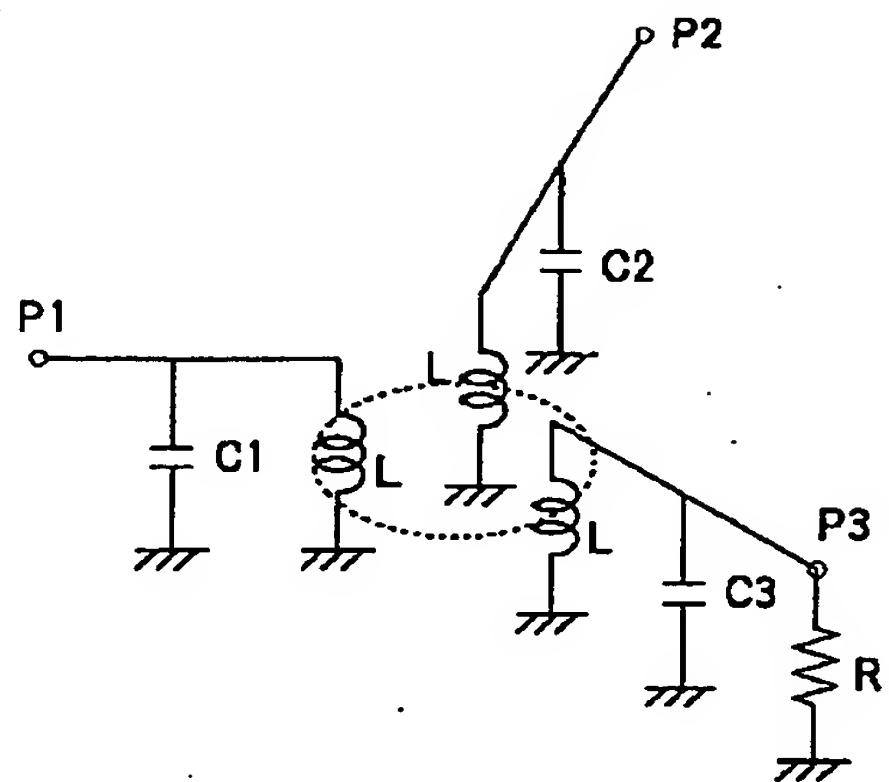
【図 8】



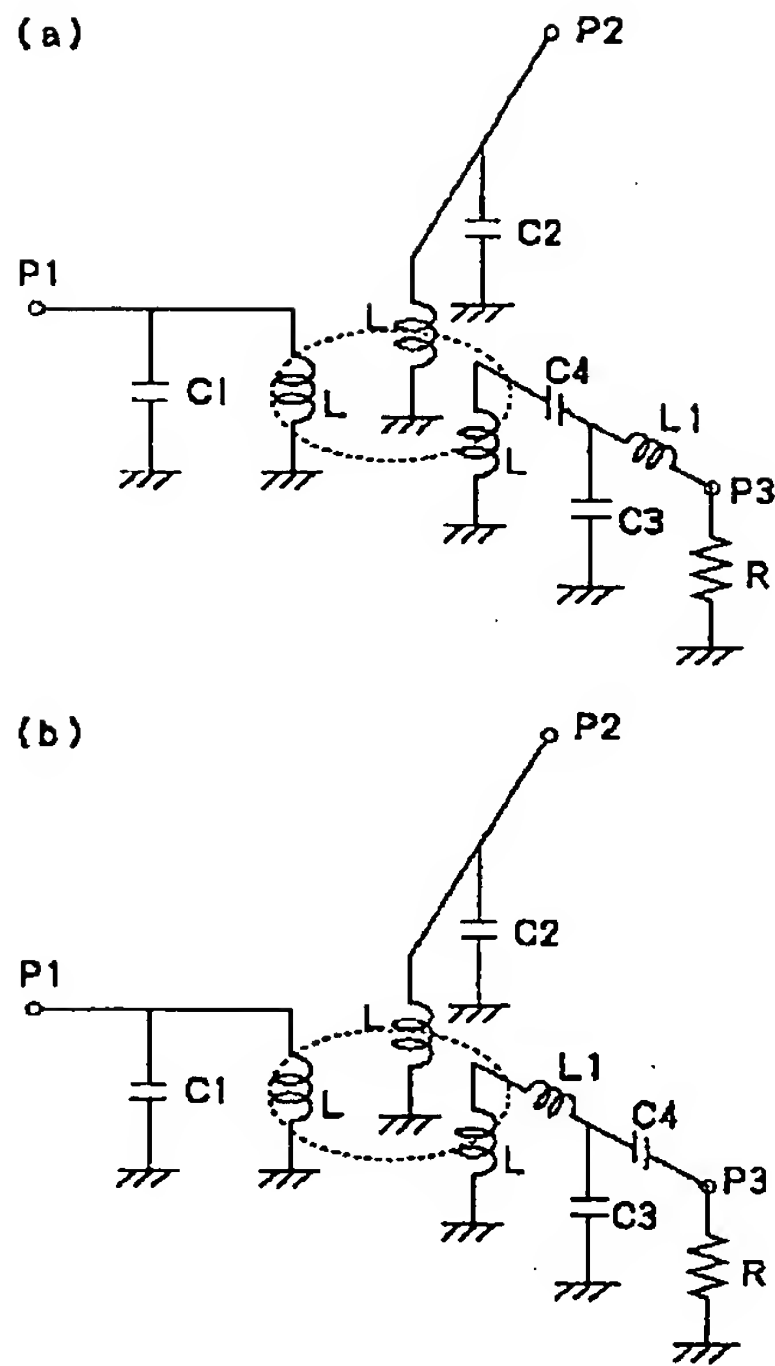
【図 6】



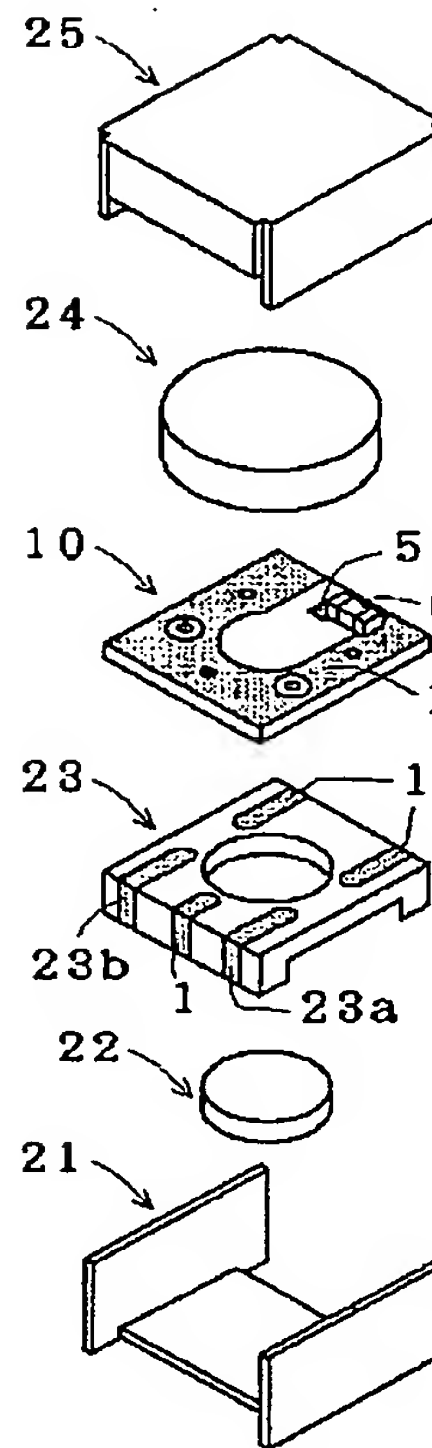
【図 10】



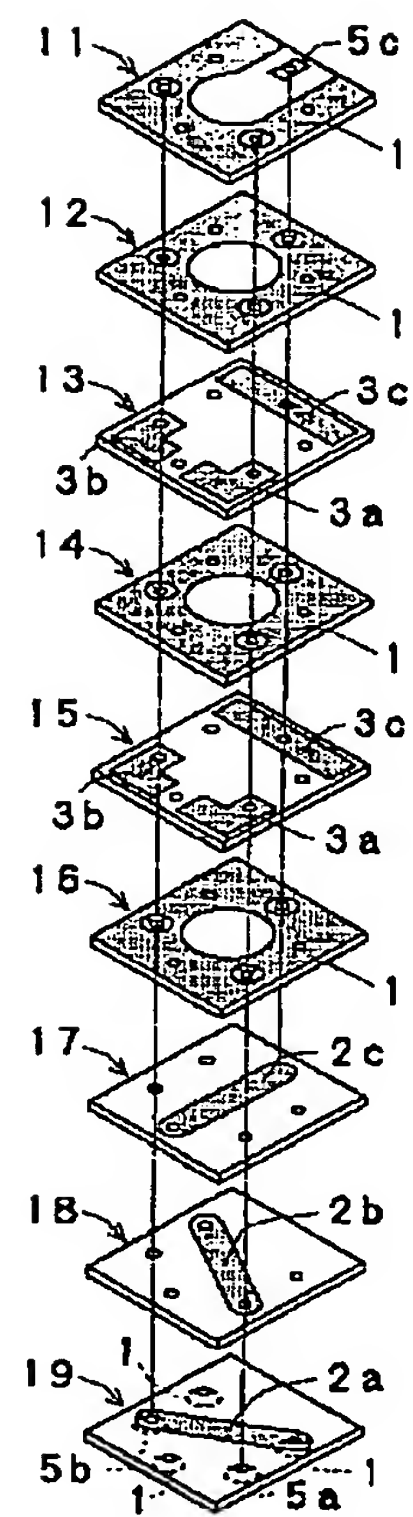
【図 9】



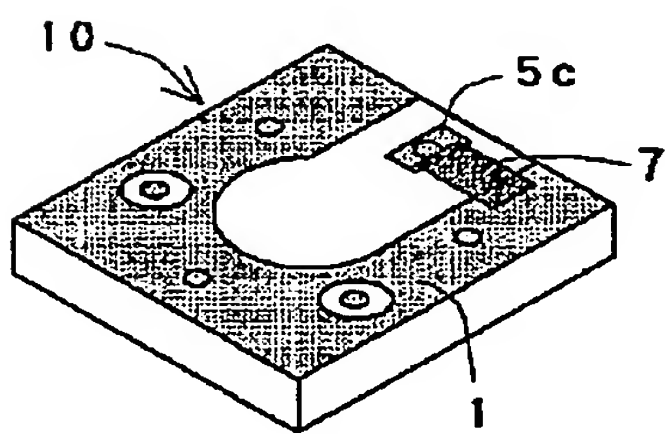
【図 11】



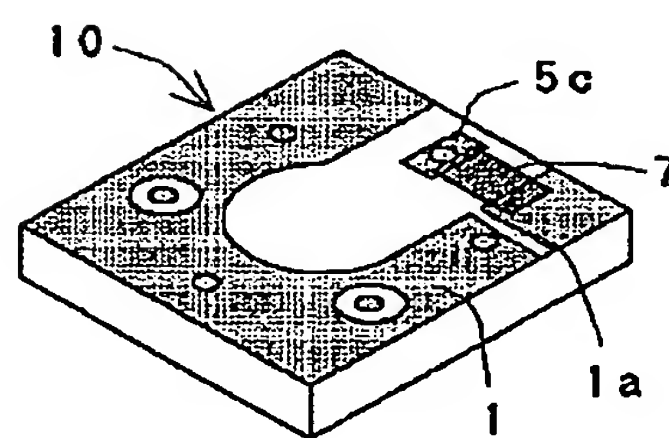
【図 12】



【図 13】



【図 14】



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CLAIMS

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[Claim(s)]

[Claim 1] The central conductor assembly constituted from an electric insulation condition by the ferrite by arranging two or more central conductors in the shape of a crossover, The resin case where it has the crevice and external terminal which position the capacitive element for adjustment connected to said each central conductor, said central conductor assembly, said capacitive element, etc., It is the concentrated-constant mold non-reciprocal circuit component which has the permanent magnet which carries out the seal of approval of the direct-current field to said ferrite, and comes to arrange these in the metal casing which serves as magnetic York. Among said central conductors The central conductor for an input and/or an output, The serial LC circuit is connected between this input and/or the output terminal, and said resin case has the crevice which positions the capacitive element said object for adjustment, and for serial LC circuits. At the pars basilaris ossis occipitalis of this crevice It has the connection electrode which flowed for the external terminal, one electrode of the capacitive element said object for adjustment and for serial LC circuits is connected on this connection electrode, and each capacitive element is arranged. The end of said central conductor The concentrated-constant mold non-reciprocal circuit component characterized by connecting with the electrode of another side of said capacitive element for adjustment, and connecting L elements between said object for an input and/or the central conductor for an output, and the electrode of another side of the capacitive element for said serial LC circuits.

[Claim 2] The concentrated-constant mold non-reciprocal circuit component according to claim 1 characterized by arranging the resin mold which has the crevice which contains said L elements, has the heights which support said capacitive element for adjustment, and has the through hole which positions a magnet on said resin case.

[Claim 3] The crevice of said resin case where said central conductor assembly is arranged is a concentrated-constant mold non-reciprocal circuit component according to claim 1 characterized by being a through hole.

[Claim 4] It is the concentrated-constant mold non-reciprocal circuit component according to claim 1 characterized by connecting and carrying out termination of the other end of at least one central conductor to resistance among the central conductors to which said serial LC circuit is not connected.

[Claim 5] Said L elements are a concentrated-constant mold non-reciprocal circuit component according to claim 1 characterized by being a chip inductor.

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[Translation done.]

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the concentrated-constant mold non-reciprocal circuit component which can control the higher harmonic of a wave 2 double wave and 3 times by measuring broadband-ization especially about concentrated-constant mold non-reciprocal circuit components used for microwave communication equipment, such as a cellular phone, etc., such as a circulator and an isolator.

[0002]

[Description of the Prior Art] Conventionally, concentrated-constant mold non-reciprocal circuit components, such as a circulator and an isolator, have the property which transmits power only in the specific direction and is not transmitted to hard flow, and are used for microwave communication equipment. It is in an insulating condition mutually, and this concentrated-constant mold non-reciprocal circuit component arranges three central conductors piled up at intervals of 120 degrees on the magnetic substance, has the permanent magnet which impresses a direct-current field to that magnetic substance, it contains these in the case used as magnetic York, and is constituted.

[0003] The decomposition perspective view of the concentrated-constant mold non-reciprocal circuit component of a conventional example is shown in drawing 5. This conventional example is a concentrated-constant mold isolator, it piled up three central conductors 8 of each other in the state of the insulation on the magnetic substance which consists of a disc-like ferrite 7 (product made from a garnet) between the upper case 1 and the bottom case 2, has arranged this central conductor assembly to the bore of a ceramic substrate 3, and arranges it on the bottom case 2 with the ceramic substrate 3. The end of each central conductor 8 is grounded by the bottom case at this time. Moreover, the other end of each central conductor 8 is connected to the electrostatic-capacity formation electrode 4 formed on the ceramic substrate 3. Termination of the electrode 4a for one electrostatic-capacity formation is connected and carried out to the earth electrode 6 through the dummy resistor 5. Moreover, the permanent magnet 9 which impresses a direct-current field to the magnetic substance is arranged at the upper case 1, this upper case 1 and the bottom case 2 are joined, and the concentrated-constant mold isolator is constituted.

[0004] Besides, a case 1 and the bottom case 2 are the magnetic substance, work as magnetic York and constitute the magnetic circuit which impresses the magnetism of a permanent magnet to a ferrite 7. Moreover, among three central conductors, the end of two central conductors 8 is extended and is used as a projection and an input/output terminal. Moreover, this central conductor assembly consists of three central conductors which project from a circular plate, arranges a ferrite on that plate, and it is turned up, and it piles up and it is constituted so that that ferrite may be wrapped in. In addition, it insulates between this central conductor.

[0005] This concentrated-constant mold non-reciprocal circuit component is used for an input terminal or output terminal side for the low pass filter which controls harmonic content in many cases, connecting, when used in microwave communication equipment, such as a cellular phone. As this low pass filter, it was constituted in many cases on the substrate with which a concentrated-constant mold non-reciprocal circuit component is mounted.

[0006]

[Problem(s) to be Solved by the Invention] For example, a cellular phone spreads with vigor frightful in recent years, and the miniaturization is also progressing quickly. And the miniaturization is demanded also for the concentrated-constant mold non-reciprocal circuit component used for the cellular phone. Moreover, not only a miniaturization but to be low cost is demanded. Moreover, since it corresponds to the escape of the frequency band by the increment in the



number of subscribers, the engine performance which covers a broadband is demanded.

[0007] The equal circuit which shows the conventional non-reciprocal circuit component to drawing 6 as circuitry for broadband-izing is known. In this conventional example, series resonant circuits 51, 52, and 53 are connected to all I/O edges. Thereby, a double hump response is acquired and can broadband-ize. In addition, in this conventional example, termination of the other end of a resonance circuit 53 is carried out by Terminator R.

[0008] Thus, with the conventional concentrated-constant mold non-reciprocal circuit component, in order to broadband-ize, the resonance circuit was connected to each I/O edge, i.e., all central conductors, and there were many component parts and they were disadvantageous structure to a miniaturization and low-cost-izing. Moreover, also in order to control harmonic content, it was the structure of connecting a low pass filter on the mounting substrate of a non-reciprocal circuit component, and was disadvantageous structure to a miniaturization and low-cost-izing.

[0009] This invention adds the function to broadband-ize for a concentrated-constant mold non-reciprocal circuit component, and to attenuate harmonic content. The low pass filter connected in the exterior of a concentrated-constant mold non-reciprocal circuit component is lost, and it aims at offering the concentrated-constant mold non-reciprocal circuit component which can attain the whole miniaturization. With moreover very simple structure It aims at offering the concentrated-constant mold non-reciprocal circuit component which can obtain high attenuation of a higher harmonic at the same time it achieves broadband-ization.

[0010]

[Means for Solving the Problem] The central conductor assembly constituted by this invention arranging two or more central conductors in the electric insulation condition in the shape of a crossover to a ferrite, The resin case where it has the crevice and external terminal which position the capacitive element for adjustment connected to said each central conductor, said central conductor assembly, said capacitive element, etc., It is the concentrated-constant mold non-reciprocal circuit component which has the permanent magnet which carries out the seal of approval of the direct-current field to said ferrite, and comes to arrange these in the metal casing which serves as magnetic York. Among said central conductors The central conductor for an input and/or an output, The serial LC circuit is connected between this input and/or the output terminal, and said resin case has the crevice which positions the capacitive element said object for adjustment, and for serial LC circuits. At the pars basilaris ossis occipitalis of this crevice It has the connection electrode which flowed for the external terminal, one electrode of the capacitive element said object for adjustment and for serial LC circuits is connected on this connection electrode, and each capacitive element is arranged. The end of said central conductor It is the concentrated-constant mold non-reciprocal circuit component by which connects with the electrode of another side of said capacitive element for adjustment, and L elements are connected between said object for an input and/or the central conductor for an output, and the electrode of another side of the capacitive element for said serial LC circuits.

[0011] Moreover, this invention is a concentrated-constant mold non-reciprocal circuit component by which the resin mold which has the crevice which contains said L elements, has the heights which support said capacitive element, and has the through hole which positions a magnet is arranged on said resin case.

[0012] Moreover, the crevice of said resin case where, as for this invention, said central conductor assembly is arranged is a concentrated-constant mold non-reciprocal circuit component used as a through hole.

[0013] Moreover, the other end of at least one central conductor is a concentrated-constant mold non-reciprocal circuit component by which termination is connected and carried out to resistance among the central conductors to which, as for this invention, said serial LC circuit is not connected.

[0014] Moreover, this invention is a concentrated-constant mold non-reciprocal circuit component said whose L elements are chip inductors.

[0015]

[Embodiment of the Invention] This invention considered setting the low pass filter connected not only to a concentrated-constant mold non-reciprocal circuit component but to the input side or output side, and miniaturizing. Moreover, it examined whether-izing could be carried out [ broadband ] in a simple circuit. And it is contained by magnetic York and only an input side makes [ an output side ] it possible to obtain high attenuation of broadband-izing and a higher harmonic by connecting LC circuit to the edge of the central conductor of only an input side and an output side at a serial into the concentrated-constant mold non-reciprocal circuit component formed into the one package.

[0016] Like before, unlike the structure of connecting a resonance circuit to all central conductors, it is only connecting a serial LC circuit alternatively, and the serial LC circuit connected to a central conductor can reduce components mark

in this invention. And in this invention, high attenuation of a higher harmonic can be obtained and connection of a low pass filter like before is made unnecessary.

[0017] That is, in this invention, a serial LC circuit measures broadband-ization and has the operation which moreover obtains high attenuation of a higher harmonic.

[0018] Although a coil can be formed and used for the inductor of the serial LC circuit of this invention by the pattern of copper foil for example, on a flexible substrate or a printed circuit board, it is desirable that it is a chip inductor.

[0019] Although a chip capacitor is sufficient as the capacitor of the serial LC circuit of this invention, it is desirable to use the veneer capacitor which prepared the electrode, for example in both sides of the sheet metal of a dielectric.

[0020] Although it is desirable to connect with both the input side of an isolator and an output side as for this serial LC circuit, it may be connected only to an input side or an output side.

[0021] This invention prepares the crevice and external terminal which position the capacitive element for the object for adjustment, and serial LC circuits in a resin case, prepares the connection electrode which flowed for the external terminal at the pars basilaris ossis occipitalis of this crevice, connects one electrode of said capacitive element on this connection electrode, and each capacitive element is arranged. And L for serial LC circuits are connected between the central conductor which the end of a central conductor is connected to the electrode of another side of the capacitive element for adjustment arranged on said connection electrode, and is connected to the terminal for an input, and/or the terminal for an output, and the electrode of another side of the capacitive element for serial LC circuits arranged on said connection electrode. Thereby, each component can be arranged efficiently and the concentrated-constant mold non-reciprocal circuit component is constituted in small and a thin shape.

[0022] Moreover, the resin case of this invention can measure thin shape-ization by having the crevice which positions a central conductor assembly, and improving connectability with a capacitive element etc., and making the crevice into the letter of penetration.

[0023] Moreover, in order to raise location precision arranged on a resin case, such as a capacitive element and L etc. elements, in this invention, and to prevent a location gap etc. and to support, the resin mold which has the crevice which contains L elements, has the heights which support said capacitive element, and has the through hole which positions a magnet is arranged on a resin case.

[0024]

[Example] The decomposition perspective view of the 1st example concerning this invention is shown in drawing 1. Moreover, the representative circuit schematic of this example is shown in drawing 2. This example is a concentrated-constant mold isolator. Moreover, the top view of the resin case of this example is shown in drawing 3. The slash section shows the electrode (connection electrode) by drawing 1 and 3. As for this example, the resin case 12 is arranged on the bottom case 11. The crevice for each part article insertion is formed, and this resin case 12 is formed every three sides where the external connection terminals 13a, 13b, 13c, 13d, 13e, and 13f counter. The other end of each of that external connection terminal 13 is the interior of the resin case 12, and has flowed with the connection electrode. The external terminals 13a and 13d flowed with connection electrode 14a, and have connected [ external terminal 13b / connection electrode 14b and external terminal 13c ] connection electrode 14e and 13f of external terminals with 14f of connection electrodes for connection electrode 14c and external terminal 13e, respectively. The central conductor assembly 16, the capacitors 17, 18, and 19 for adjustment, and a resistance element 20 are arranged in the crevice for components insertion of the resin case 12. Moreover, the capacitors 21 and 22 for serial LC circuits are arranged.

[0025] Three central conductors 24, 25, and 26 are inserted in so that this central conductor assembly 16 may wrap in a ferrite 23. On both sides of an insulation sheet, it insulates mutually on the whole surface of a ferrite 23 between each central conductor, and this central conductor crosses at the predetermined include angle. This central conductor assembly 16 is arranged at the hole 15 of the center of the resin case 12, this hole 15 is penetrated, the lower part of a ferrite 23 joins to the bottom case 11, and each central conductor has structure grounded by the end.

[0026] Resin case 12 part of this example is further explained to a detail. The capacitors 17, 18, and 19 for adjustment are arranged on the connection electrodes 14a and 14b of the resin case 12, and 14e. The capacitors 17, 18, and 19 for this adjustment are plate capacitors, and one electrode flows through them with that connection electrode. Moreover, a resistance element 20 is arranged on connection electrode 14a of the resin case 12. One electrode is extended to the lower part and this resistance element 20 flows with a connection electrode. And each central conductors 24, 25, and 26 are arranged on each capacitors 17 and 18 for adjustment, and 19, and the electrode and each central conductor of

another side of each capacitors 17, 18, and 19 for adjustment flow. Moreover, the electrode of another side of a resistance element 20 flows through a central conductor 24.

[0027] Moreover, the capacitors 21 and 22 for serial LC circuits are arranged on connection electrode 14c of the resin case 12, and 14f. These capacitors 21 and 22 for serial LC circuits are also plate capacitors, and one electrode flows through them with those connection electrodes 14c and 14f. And the inductors 27 and 28 for serial LC circuits are arranged and connected between the upper electrode of the capacitors 21 and 22 for the serial LC circuits, and central conductors 25 and 26. This situation is shown in drawing 4.

[0028] And the permanent magnet 30 was positioned by the resin mold 29, the upper case 31 was put, and the concentrated-constant mold isolator was constituted. In addition, this resin mold 29 also has the heights which the crevice 32 which contains inductors 27 and 28 is formed, and support a central conductor and the capacitor for adjustment, and has the work which controls these location gaps etc. To the conventional structure, it is the structure which connected inductors 27 and 28 and capacitors 21 and 22 to the input side and the output side at the serial, and the former and the same size were able to constitute the concentrated-constant mold isolator from this example.

[0029] In this example, using the garnet of 3.9mmphi, and the permanent magnet of 5.5mmphi, it was 7mm angle, small [ with a height of 2mm ], and a thin concentrated-constant mold isolator, and the isolator for 889-960MHz ( $f_0$ :924.5MHz) bands was constituted, and the property shown in Table 1 was acquired.

[0030]

[Table 1]

	挿入損失 (dB)	2倍波減衰量 (dB)	3倍波減衰量 (dB)	VSWR
実施例	0.7	38	41	1.3
比較例	0.6	23	23	1.5

[0031] As shown in Table 1, in the example of this invention, although an insertion loss increases a little, it can broadband-ize VSWR, and can be raising sharply the amount of 2 double decay of waves of center frequency ( $f_0$ ), and the amount of 3 time decay of waves. The example of a comparison of this table 1 is the case of the structure where the inductors 27 and 28 of an example and capacitors 21 and 22 are not connected.

[0032] Although the chip inductor was used as an inductor for serial LC circuits in the above-mentioned example, you may be the inductor of other configurations. Moreover, the laminating LC chip which carried out the laminating may be used for one as the inductor and capacitor for serial LC circuits.

[0033] In the above-mentioned example, although the serial LC circuit of an inductor and a capacitor was connected to the input edge and the outgoing end, you may connect with either an input one end side or an outgoing end side. Moreover, although the isolator explained in the above-mentioned example, it is the same even if it is a circulator.

[0034] While measuring broadband-ization by connecting an inductor and a capacitor only to an input side, an output side or an input side, and an output side at a serial according to the example of this invention, 2 double wave and the higher harmonic of a 3 time wave can be controlled, components called the low pass filter conventionally added as another components can be eliminated, and advanced features of a concentrated-constant mold non-reciprocal circuit component and the miniaturization of a microwave device can be attained.

[0035]

[Effect of the Invention] In a concentrated-constant mold non-reciprocal circuit component, by connecting the serial LC circuit of an inductor and a capacitor to the central conductor of an input side and/or an output side, while measuring broadband-ization, according to this invention, the concentrated-constant mold non-reciprocal circuit component which can obtain high attenuation of a higher harmonic can be obtained. Moreover, using a resin case, it is surface mounting, and it is the concentrated-constant mold non-reciprocal circuit component moreover collected into the compact, and high attenuation of a higher harmonic can be obtained. Moreover, one component can attain what has the required components of the conventional plurality. Moreover, it is the former and the same size also as a concentrated-constant mold non-reciprocal circuit component, and moreover, it is attained with easy structure and is very useful to the miniaturization of a device, and low-cost-izing.



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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the concentrated-constant mold non-reciprocal circuit component which can control the higher harmonic of a wave 2 double wave and 3 times by measuring broadband-ization especially about concentrated-constant mold non-reciprocal circuit components used for microwave communication equipment, such as a cellular phone, etc., such as a circulator and an isolator.

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PRIOR ART

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[Description of the Prior Art] Conventionally, concentrated-constant mold non-reciprocal circuit components, such as a circulator and an isolator, have the property which transmits power only in the specific direction and is not transmitted to hard flow, and are used for microwave communication equipment. It is in an insulating condition mutually, and this concentrated-constant mold non-reciprocal circuit component arranges three central conductors piled up at intervals of 120 degrees on the magnetic substance, has the permanent magnet which impresses a direct-current field to that magnetic substance, it contains these in the case used as magnetic York, and is constituted.

[0003] The decomposition perspective view of the concentrated-constant mold non-reciprocal circuit component of a conventional example is shown in drawing 5. This conventional example is a concentrated-constant mold isolator, it piled up three central conductors 8 of each other in the state of the insulation on the magnetic substance which consists of a disc-like ferrite 7 (product made from a garnet) between the upper case 1 and the bottom case 2, has arranged this central conductor assembly to the bore of a ceramic substrate 3, and arranges it on the bottom case 2 with the ceramic substrate 3. The end of each central conductor 8 is grounded by the bottom case at this time. Moreover, the other end of each central conductor 8 is connected to the electrostatic-capacity formation electrode 4 formed on the ceramic substrate 3. Termination of the electrode 4a for one electrostatic-capacity formation is connected and carried out to the earth electrode 6 through the dummy resistor 5. Moreover, the permanent magnet 9 which impresses a direct-current field to the magnetic substance is arranged at the upper case 1, this upper case 1 and the bottom case 2 are joined, and the concentrated-constant mold isolator is constituted.

[0004] Besides, a case 1 and the bottom case 2 are the magnetic substance, work as magnetic York and constitute the magnetic circuit which impresses the magnetism of a permanent magnet to a ferrite 7. Moreover, among three central conductors, the end of two central conductors 8 is extended and is used as a projection and an input/output terminal. Moreover, this central conductor assembly consists of three central conductors which project from a circular plate, arranges a ferrite on that plate, and it is turned up, and it piles up and it is constituted so that that ferrite may be wrapped in. In addition, it insulates between this central conductor.

[0005] This concentrated-constant mold non-reciprocal circuit component is used for an input terminal or output terminal side for the low pass filter which controls harmonic content in many cases, connecting, when used in microwave communication equipment, such as a cellular phone. As this low pass filter, it was constituted in many cases on the substrate with which a concentrated-constant mold non-reciprocal circuit component is mounted.

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EFFECT OF THE INVENTION

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[Effect of the Invention] In a concentrated-constant mold non-reciprocal circuit component, by connecting the serial LC circuit of an inductor and a capacitor to the central conductor of an input side and/or an output side, while measuring broadband-ization, according to this invention, the concentrated-constant mold non-reciprocal circuit component which can obtain high attenuation of a higher harmonic can be obtained. Moreover, using a resin case, it is surface mounting, and it is the concentrated-constant mold non-reciprocal circuit component moreover collected into the compact, and high attenuation of a higher harmonic can be obtained. Moreover, one component can attain what has the required components of the conventional plurality. Moreover, it is the former and the same size also as a concentrated-constant mold non-reciprocal circuit component, and moreover, it is attained with easy structure and is very useful to the miniaturization of a device, and low-cost-izing.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] For example, a cellular phone spreads with vigor frightful in recent years, and the miniaturization is also progressing quickly. And the miniaturization is demanded also for the concentrated-constant mold non-reciprocal circuit component used for the cellular phone. Moreover, not only a miniaturization but to be low cost is demanded. Moreover, since it corresponds to the escape of the frequency band by the increment in the number of subscribers, the engine performance which covers a broadband is demanded.

[0007] The equal circuit which shows the conventional non-reciprocal circuit component to drawing 6 as circuitry for broadband-izing is known. In this conventional example, series resonant circuits 51, 52, and 53 are connected to all I/O edges. Thereby, a double hump response is acquired and can broadband-ize. In addition, in this conventional example, termination of the other end of a resonance circuit 53 is carried out by Terminator R.

[0008] Thus, with the conventional concentrated-constant mold non-reciprocal circuit component, in order to broadband-ize, the resonance circuit was connected to each I/O edge, i.e., all central conductors, and there were many component parts and they were disadvantageous structure to a miniaturization and low-cost-izing. Moreover, also in order to control harmonic content, it was the structure of connecting a low pass filter on the mounting substrate of a non-reciprocal circuit component, and was disadvantageous structure to a miniaturization and low-cost-izing.

[0009] This invention adds the function to broadband-ize for a concentrated-constant mold non-reciprocal circuit component, and to attenuate harmonic content. The low pass filter connected in the exterior of a concentrated-constant mold non-reciprocal circuit component is lost, and it aims at offering the concentrated-constant mold non-reciprocal circuit component which can attain the whole miniaturization. With moreover very simple structure It aims at offering the concentrated-constant mold non-reciprocal circuit component which can obtain high attenuation of a higher harmonic at the same time it achieves broadband-ization.

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MEANS

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[Means for Solving the Problem] The central conductor assembly constituted by this invention arranging two or more central conductors in the electric insulation condition in the shape of a crossover to a ferrite, The resin case where it has the crevice and external terminal which position the capacitive element for adjustment connected to said each central conductor, said central conductor assembly, said capacitive element, etc.; It is the concentrated-constant mold non-reciprocal circuit component which has the permanent magnet which carries out the seal of approval of the direct-current field to said ferrite, and comes to arrange these in the metal casing which serves as magnetic York. Among said central conductors The central conductor for an input and/or an output, The serial LC circuit is connected between this input and/or the output terminal, and said resin case has the crevice which positions the capacitive element said object for adjustment, and for serial LC circuits. At the pars basilaris ossis occipitalis of this crevice It has the connection electrode which flowed for the external terminal, one electrode of the capacitive element said object for adjustment and for serial LC circuits is connected on this connection electrode, and each capacitive element is arranged. The end of said central conductor It is the concentrated-constant mold non-reciprocal circuit component by which connects with the electrode of another side of said capacitive element for adjustment, and L elements are connected between said object for an input and/or the central conductor for an output, and the electrode of another side of the capacitive element for said serial LC circuits.

[0011] Moreover, this invention is a concentrated-constant mold non-reciprocal circuit component by which the resin mold which has the crevice which contains said L elements, has the heights which support said capacitive element, and has the through hole which positions a magnet is arranged on said resin case.

[0012] Moreover, the crevice of said resin case where, as for this invention, said central conductor assembly is arranged is a concentrated-constant mold non-reciprocal circuit component used as a through hole.

[0013] Moreover, the other end of at least one central conductor is a concentrated-constant mold non-reciprocal circuit component by which termination is connected and carried out to resistance among the central conductors to which, as for this invention, said serial LC circuit is not connected.

[0014] Moreover, this invention is a concentrated-constant mold non-reciprocal circuit component said whose L elements are chip inductors.

[0015]

[Embodiment of the Invention] This invention considered setting the low pass filter connected not only to a concentrated-constant mold non-reciprocal circuit component but to the input side or output side, and miniaturizing. Moreover, it examined whether-izing could be carried out [ broadband ] in a simple circuit. And it is contained by magnetic York and only an input side makes [ an output side ] it possible to obtain high attenuation of broadband-izing and a higher harmonic by connecting LC circuit to the edge of the central conductor of only an input side and an output side at a serial into the concentrated-constant mold non-reciprocal circuit component formed into the one package.

[0016] Like before, unlike the structure of connecting a resonance circuit to all central conductors, it is only connecting a serial LC circuit alternatively, and the serial LC circuit connected to a central conductor can reduce components mark in this invention. And in this invention, high attenuation of a higher harmonic can be obtained and connection of a low pass filter like before is made unnecessary.

[0017] That is, in this invention, a serial LC circuit measures broadband-ization and has the operation which moreover obtains high attenuation of a higher harmonic.

[0018] Although a coil can be formed and used for the inductor of the serial LC circuit of this invention by the pattern

of copper foil for example, on a flexible substrate or a printed circuit board, it is desirable that it is a chip inductor.

[0019] Although a chip capacitor is sufficient as the capacitor of the serial LC circuit of this invention, it is desirable to use the veneer capacitor which prepared the electrode, for example in both sides of the sheet metal of a dielectric.

[0020] Although it is desirable to connect with both the input side of an isolator and an output side as for this serial LC circuit, it may be connected only to an input side or an output side.

[0021] This invention prepares the crevice and external terminal which position the capacitative element for the object for adjustment, and serial LC circuits in a resin case, prepares the connection electrode which flowed for the external terminal at the pars basilaris ossis occipitalis of this crevice, connects one electrode of said capacitative element on this connection electrode, and each capacitative element is arranged. And L for serial LC circuits are connected between the central conductor which the end of a central conductor is connected to the electrode of another side of the capacitative element for adjustment arranged on said connection electrode, and is connected to the terminal for an input, and/or the terminal for an output, and the electrode of another side of the capacitative element for serial LC circuits arranged on said connection electrode. Thereby, each component can be arranged efficiently and the concentrated-constant mold non-reciprocal circuit component is constituted in small and a thin shape.

[0022] Moreover, the resin case of this invention can measure thin shape-ization by having the crevice which positions a central conductor assembly, and improving connectability with a capacitative element etc., and making the crevice into the letter of penetration.

[0023] Moreover, in order to raise location precision arranged on a resin case, such as a capacitative element and L etc. elements, in this invention, and to prevent a location gap etc. and to support, the resin mold which has the crevice which contains L elements, has the heights which support said capacitative element, and has the through hole which positions a magnet is arranged on a resin case.

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## EXAMPLE

[Example] The decomposition perspective view of the 1st example concerning this invention is shown in drawing 1 . Moreover, the representative circuit schematic of this example is shown in drawing 2 . This example is a concentrated-constant mold isolator. Moreover, the top view of the resin case of this example is shown in drawing 3 . The slash section shows the electrode (connection electrode) by drawing 1 and 3. As for this example, the resin case 12 is arranged on the bottom case 11. The crevice for each part article insertion is formed, and this resin case 12 is formed every three sides where the external connection terminals 13a, 13b, 13c, 13d, 13e, and 13f counter. The other end of each of that external connection terminal 13 is the interior of the resin case 12, and has flowed with the connection electrode. The external terminals 13a and 13d flowed with connection electrode 14a, and have connected [ external terminal 13b / connection electrode 14b and external terminal 13c ] connection electrode 14e and 13f of external terminals with 14f of connection electrodes for connection electrode 14c and external terminal 13e, respectively. The central conductor assembly 16, the capacitors 17, 18, and 19 for adjustment, and a resistance element 20 are arranged in the crevice for components insertion of the resin case 12. Moreover, the capacitors 21 and 22 for serial LC circuits are arranged.

[0025] Three central conductors 24, 25, and 26 are inserted in so that this central conductor assembly 16 may wrap in a ferrite 23. On both sides of an insulation sheet, it insulates mutually on the whole surface of a ferrite 23 between each central conductor, and this central conductor crosses at the predetermined include angle. This central conductor assembly 16 is arranged at the hole 15 of the center of the resin case 12, this hole 15 is penetrated, the lower part of a ferrite 23 joins to the bottom case 11, and each central conductor has structure grounded by the end.

[0026] Resin case 12 part of this example is further explained to a detail. The capacitors 17, 18, and 19 for adjustment are arranged on the connection electrodes 14a and 14b of the resin case 12, and 14e. The capacitors 17, 18, and 19 for this adjustment are plate capacitors, and one electrode flows through them with that connection electrode. Moreover, a resistance element 20 is arranged on connection electrode 14a of the resin case 12. One electrode is extended to the lower part and this resistance element 20 flows with a connection electrode. And each central conductors 24, 25, and 26 are arranged on each capacitors 17 and 18 for adjustment, and 19, and the electrode and each central conductor of another side of each capacitors 17, 18, and 19 for adjustment flow. Moreover, the electrode of another side of a resistance element 20 flows through a central conductor 24.

[0027] Moreover, the capacitors 21 and 22 for serial LC circuits are arranged on connection electrode 14c of the resin case 12, and 14f. These capacitors 21 and 22 for serial LC circuits are also plate capacitors, and one electrode flows through them with those connection electrodes 14c and 14f. And the inductors 27 and 28 for serial LC circuits are arranged and connected between the upper electrode of the capacitors 21 and 22 for the serial LC circuits, and central conductors 25 and 26. This situation is shown in drawing 4 .

[0028] And the permanent magnet 30 was positioned by the resin mold 29, the upper case 31 was put, and the concentrated-constant mold isolator was constituted. In addition, this resin mold 29 also has the heights which the crevice 32 which contains inductors 27 and 28 is formed, and support a central conductor and the capacitor for adjustment, and has the work which controls these location gaps etc. To the conventional structure, it is the structure which connected inductors 27 and 28 and capacitors 21 and 22 to the input side and the output side at the serial, and the former and the same size were able to constitute the concentrated-constant mold isolator from this example.

[0029] In this example, using the garnet of 3.9mmphi, and the permanent magnet of 5.5mmphi, it was 7mm angle, small [ with a height of 2mm ], and a thin concentrated-constant mold isolator, and the isolator for 889-960MHz

(f0:924.5MHz) bands was constituted, and the property shown in Table 1 was acquired.

[0030]

[Table 1]

	挿入損失 ( d B )	2 倍波減衰量 ( d B )	3 倍波減衰量 ( d B )	V S W R
実施例	0 . 7	3 8	4 1	1 . 3
比較例	0 . 6	2 3	2 3	1 . 5

[0031] As shown in Table 1, in the example of this invention, although an insertion loss increases a little, it can broadband-ize VSWR, and can be raising sharply the amount of 2 double decay of waves of center frequency (f0), and the amount of 3 time decay of waves. The example of a comparison of this table 1 is the case of the structure where the inductors 27 and 28 of an example and capacitors 21 and 22 are not connected.

[0032] Although the chip inductor was used as an inductor for serial LC circuits in the above-mentioned example, you may be the inductor of other configurations. Moreover, the laminating LC chip which carried out the laminating may be used for one as the inductor and capacitor for serial LC circuits.

[0033] In the above-mentioned example, although the serial LC circuit of an inductor and a capacitor was connected to the input edge and the outgoing end, you may connect with either an input one end side or an outgoing end side. Moreover, although the isolator explained in the above-mentioned example, it is the same even if it is a circulator.

[0034] While measuring broadband-ization by connecting an inductor and a capacitor only to an input side, an output side or an input side, and an output side at a serial according to the example of this invention, 2 double wave and the higher harmonic of a 3 time wave can be controlled, components called the low pass filter conventionally added as another components can be eliminated, and advanced features of a concentrated-constant mold non-reciprocal circuit component and the miniaturization of a microwave device can be attained.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the decomposition perspective view of the 1st example concerning this invention.

[Drawing 2] It is the representative circuit schematic of the 1st example concerning this invention.

[Drawing 3] It is the top view of the resin case of the 1st example concerning this invention.

[Drawing 4] It is the central conductor of the 1st example and the explanatory view of the connection of a serial LC circuit concerning this invention.

[Drawing 5] It is the decomposition perspective view of the conventional example.

[Drawing 6] It is the representative circuit schematic of a conventional example.

[Description of Notations]

11 Bottom Case

12 Resin Case

13a, 13b, 13c, 13d, 13e, 13f External terminal

14a, 14b, 14c, 14e, 14f Connection electrode

15 Through Hole

16 Central Conductor Assembly

17, 18, 19 Capacitor for adjustment

20 Resistance Element

21 22 Capacitor for serial LC circuits

23 Ferrite

24, 25, 26 Central conductor

27 28 Inductor for serial LC circuits

29 Resin Mold

30 Magnet

31 Upper Case

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[Translation done.]